

**Research Article****A Comprehensive Study of Drowning in and Around Kakinada, Two Years Retrospective Study****G.S.R.K.G. Ranga Rao<sup>1</sup>, Jakkam Surendar<sup>2</sup>, G.K.V. Prasad<sup>3</sup>**<sup>1</sup>Associate Professor, Department of Forensic Medicine, KIMS&RF, Amalapuram, East Godavari, Andhra Pradesh-533201, India<sup>2</sup>Assistant Professor, Department of Forensic Medicine, KIMS&RF, Amalapuram, East Godavari, Andhra Pradesh-533201, India<sup>3</sup>Professor, Department of Forensic Medicine, KIMS&RF, Amalapuram, East Godavari, Andhra Pradesh-533201, India**\*Corresponding author**

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**Abstract:** India is a vast country having plenty of water supplies from rivers, ponds, well and an extensive sea coast. So drowning is one of the most common causes of death in all manners of death in this country. The present study is a retrospective study of two years from 2010 to 2011. This study was done in the mortuary of Rangaraya Medical College, Kakinada, Andhra Pradesh. We studied total 1315 cases in two years. Out of this 90 cases were drowning. It occupies 5<sup>th</sup> place in the cause of death. Out of 90 cases the total number of known cases were 73 (81.11%) and unknown cases were 17(18.88%), 57 were males (63.33 %) and 33 were females (36.67 %). 41 cases were married, in which 23 males (47.32%) and 18 females (42.55%) and 32 cases are unmarried out of which 21 are males (50.31%) and 11 females (22.09 %)**Keywords:** drowning, rivers, ponds, death

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**INTRODUCTION**

India is a vast country having plenty of water supplies from rivers, ponds, wells and an extensive seacoast. Under such conducive circumstances, it is a matter of small wonder that cause of death due to drowning is a frequent event where medico legal expertise called upon to investigate. It has been suggested that the term "drowning" should be used to denote the process resulting from submersion in water in which there is loss of consciousness and a threat to life [2, 3]. Drowning occurs when an individual is unable to remain float in water. Complete submersion is not necessary. Submersion of nose and mouth alone for a sufficient period can cause death from drowning. Although the precise mechanism is complex, is modified by the medium and the other factors. Pathophysiological proof is often difficult or is even impossible to obtain.

Bodies taken from the water may have: Died of natural cause before falling in (heart attacks on the edge of the well, river banks, epilepsy and so on), Died of natural causes in the water (cardiac deaths while swimming), Died of injuries before falling or being thrown into the water (head injuries etc.), Suffered injuries while falling into water (against bridge piers walls, etc.), Suffered injuries while in the water (boats,

propellers, bridges, rocks, etc.), Suffered death from immersion [2, 4].

The autopsy diagnosis of death by drowning can be one of the most difficult problems in forensic pathology because in our Indian set up the time required to complete the inquest formalities and transport of the body to the mortuary is enough to cause the decomposition which masks the most of the postmortem evidences of cause of death. And most of the bodies recovered from water are in various stages of decomposition. Some murderers dispose off the dead bodies of their victims in the rivers, seas and wells to simulate death due to drowning [16]. Some times unwanted bodies are thrown into water. In advanced decomposed and skeletonised bodies the only method of identifying the classical ante mortem drowning is estimation of the diatoms from the bone marrow and of comparing them with the diatoms available in the water [1, 5, 9, 10, 13, 14]. The present study also concentrates on this problem.

Keeping in view the above facts the present study is taken up to acquire knowledge about:

- Present trends in drowning by statistical analysis.
- To know the latest advances in the study of immersion deaths.

- Study the water diatoms and tally them with sternal bone marrow diatoms [15].
- To know the validity of diatom test [12].

#### MATERIALS AND METHODS

The present study is based on the autopsies conducted in the mortuary of Rangaraya medical college, Kakinada, by the Department of Forensic Medicine, during the calendar year 2010 to 2012. The statistical analysis of these cases of drowning with regard to general incidence, age, sex, marital, suicidal, accidental or homicidal and epidemiology and so on are worked out. The diatoms from the sternal bone marrow of the cases were analyzed by acid digestion and were compared with the water diatoms from the same source [15]. The results were presented.

#### RESULTS

A total of 596 medico legal autopsies were conducted during the calendar year 2010 out of these cases 224 (37.58%) were due to injuries by means of road transport accidents, railway accidents and fall from height etc. followed by means of poisoning are 158 (26.51%), Third being flame burns and scalds, which were 143 (23.99%). Drowning stood in fourth place with 42 cases (7.05%). Hanging stands fifth in frequency; numbers of cases were 15 (2.52%).

Same way a total of 719 medico legal autopsies were conducted in 2011 among these death due to injuries (RTA, RLY and fall from height) took the first place, number of cases were 321 (44.65) and second place is occupied by death due to flame burns and scalds. Numbers of cases were 146 (20.31) and third place is occupied by poisoning having 146 (20.31%). Fourth place is occupied by drowning with 48 cases (6.68%). Fifth place is occupied by hanging.

Almost the same trend is continued for 2010 - 2011 together with fifth place being occupied by drowning. Out of total 1315 cases, 90 (14.44%) cases were due to drowning.

During 2010 total numbers of autopsies were 596, out of which, 42 cases were of drowning among 60 Asphyxial deaths (drowning 42, hanging 15, strangulation 1, suffocation 2.). Hanging stood second i.e., next to drowning. Out of total 42 cases in 2010, known cases were 37(87.28%). Number of unknown cases were 5(12.69%), 24 were males (57.14%) and 18 were females (42.86%). and 21 cases of married, of which males were 12(28.57%), females were 9 in number (23.80%). 16 cases were unmarried (34.91%) with in this males were 9(20.63) and females were 7(14.28%). Among the drowning cases, accidental drowning stood first. The number of cases being 19 (46.03%) and next comes suicide, cases were 15 (34.92%). Unknown and undetected cases were 8 (19.04%) (Table 1).

When age group frequency was taken into consideration minimum number of cases 1(2.38%) were appeared in the first decade. The maximum were in fourth decade i.e., 15 cases (35.71%) (Table 1). The month wise incidence was taken into consideration in 2010, maximum number of cases were appeared in April to June and the minimum number of cases were appeared in July and September (Table 2). Out of the total 42 cases of immersion deaths Well & Lake drowned are 32 in numbers i.e., 76.19% next comes the Seawater, the number of cases were 6(14.28%). Drainage stood third in position, cases were 2(4.76%). Canal death cases i.e., 2 come to 4.76%, standing fourth in position (Fig. 1). Out of 42 cases 38 (90.4%) cases are showing positive results for same diatoms in bone marrow and sample water, in 3(7.2%) cases sample water is showing positive results, 1(2.4%) case is showing no diatoms in bone marrow and sample water.

During 2011 total numbers of autopsies conducted were 719 out of which 48 cases were due to drowning. Total numbers of Asphyxial deaths were 73 (hanging 25, drowning 48, suffocation 0, and smothering 0.), here also hanging stood second, where as drowning stood first. Out of total 48 cases in 2011, 36(76.56%) were known and 12(23.43%) were unknown, 33 were males (68.75%) and 15 were females (31.25%). out of 48 cases, 20 cases were of married, out of which 11 male (20.31%) and 9 female (18.75%) and 16 were unmarried, out of which 12 were males i.e., 29.68% and 4 were females (7.81%) and unknown cases were 12 in number and out of which 10 males (20.31%) and 2 females (3.12%). Among the drowning cases in 2011 accidental drowning stood first. The number of cases being 23 (47.91%) and next comes suicide, cases are 16 (33.33%). Unknown and undetected cases are 9 (18.75%) (Table 3).

When age group frequency was taken into consideration in 2011 minimum number of cases 0 (0%) were appeared in the seventh decade. The maximum were in third decade i.e., 17 cases (35.41%) (Table 3). When month wise incidence was taken into consideration, maximum number of cases was appeared in April to June and the minimum number of cases was appeared in the month of October to December (Fig. 2). Out of the total 48 cases of immersion deaths in Wells & Lakes drowned were 37 in numbers i.e., 77.08% next comes the Seawater, the number of cases were 6(12.5%). Drainage stood third in position, cases were 3 (6.25%). Canal death cases i.e., 2 come to 4.16%, standing fourth in position (Fig. 2). Out of 48 cases 42(87.5%) cases were showing positive results for same diatoms in bone marrow and sample water, in 4(8.3%) cases sample water is showing positive results, 2 (4.2%) cases were showing no diatoms in bone marrow and sample water.

Out of 90 cases in 2010 - 2011, the total number of known cases were 73 i.e., 81.11% and the total

number of unknown cases were 17 ( 18.88%), 57 were males ( 63.33 %) and 33 were females (36.67 %). 41 cases were married, in which 23 males (47.32%) and 18 females (42.55%) and 32 cases were unmarried out of which 21 are males ( 50.31%) and 11 females (22.09 %) and 17 were unknown cases out of which 13 were males and 4 were females. When age group frequency was taken into consideration minimum number of cases 4

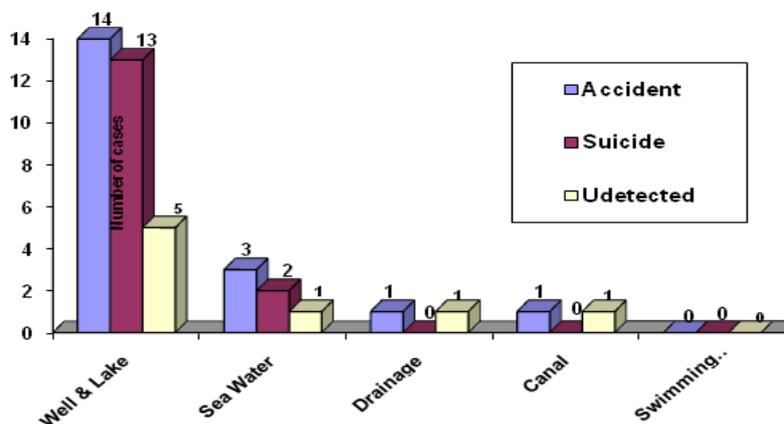
(4.44 %) were appeared in the first decade. The maximum were in third and fourth decades i.e., 51cases (56.66%). Out of 90 cases 80(80.9%) cases are showing positive results for same diatoms in bone marrow and sample water, in 7(7.8%) cases, sample water showing positive results, 3(3.3%) cases were showing no diatoms in bone marrow and sample water [6-8].

**Table 1: A decade wise analysis of drowning cases – 2010**

Age group	Married		Unmarried		Unknown	
	Male	Female	Male	Female	Male	Female
00 – 10 years	0	0	0	1	0	0
11 – 20 years	0	1	1	1	0	0
21 – 30 years	2	2	3	1	1	0
31 – 40 years	6	3	3	1	1	1
41 – 50 years	2	2	1	1	1	1
51 – 60 years	1	1	1	1	0	0
61 – 70 years	1	0	0	1	0	0
Total	12	9	9	7	3	2
Percentage	28.57	23.80	20.63	14.28	07.93	04.76

**Table 2: Month wise occurrence of drowning case – 2010**

Month	Male	Female	Percentage
January-March	6	3	21.42
April-June	9	6	35.71
July-September	5	3	19.04
October-December	7	3	23.80
Total	27	15	100



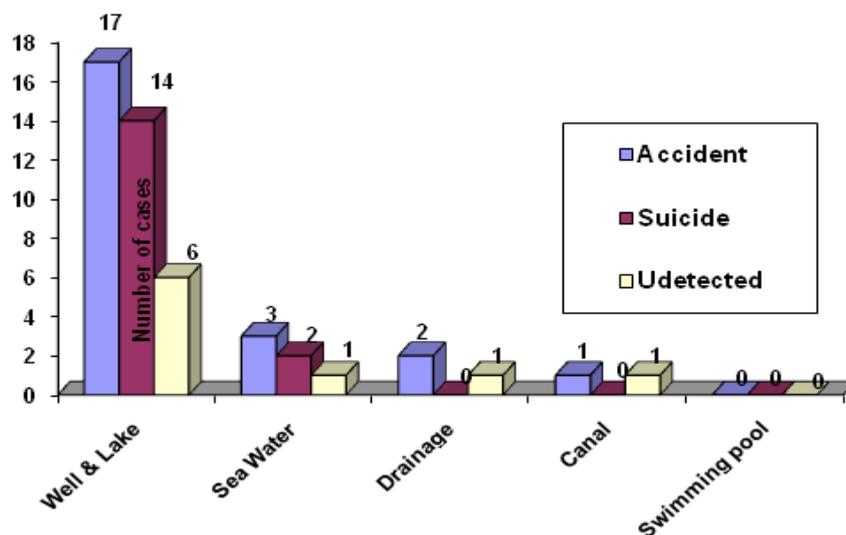
**Fig. 1: Cases of drowning in respect to medium of immersion 2010**

**Table 3: A decade wise analysis of drowning cases – 2011**

Age group	Married		Unmarried		Unknown	
	Male	Female	Male	Female	Male	Female
00 – 10 years	0	1	1	0	1	0
11 – 20 years	2	2	2	1	2	0
21 – 30 years	4	3	4	2	3	1
31 – 40 years	1	2	2	1	3	1
41 – 50 years	1	1	2	0	1	0
51 – 60 years	1	0	1	0	0	0
61 – 70 years	0	0	0	0	0	0
Total	11	9	12	4	10	2
Percentage	18.75	20.31	29.68	07.81	20.31	03.12

**Table 4: Month wise occurrence of drowning case – 2011**

Month	Male	Female	Percentage
January-March	8	4	25.00
April-June	9	5	29.17
July-September	8	4	24.99
October-December	7	3	20.83
Total	32	16	100



**Fig. 2: Cases of drowning in respect to medium of immersion 2011**

**Table 5: Diatoms test**

Diatoms	Number of cases	Percentage
Present in sample & bone marrow	80	88.9
Present only in water samples	7	7.8
Absent in sample & bone marrow	2	3.3

**DISCUSSION AND CONCLUSION**

Drowning is one of the commonest modes of death. About 6.84% of autopsies conducted in the mortuary of Government General Hospital, Kakinada are due to drowning.

In deaths due to mechanical asphyxia drowning occupies the first place in the competition with hanging.

Among drowning cases 69(76.66 %) of the persons are drowned in the wells, 12(13.33 %) are drowned in the seawater and about 5(5.55 %) were drowned in drainage and canals. This distribution is because of the area under our jurisdiction consists mostly rural, suburban area surrounding the Kakinada where agriculture is a major source of income.

42(46.66 %) of deaths were occurred due to accidental drowning, while swimming in wells, lakes and seawater. The victims were of young age group mostly of second decade boys. Because of over enthusiasm in swimming and lack of proper supervision, no case of suicide was noted in the first decade and almost all the cases were accidental.

As the age advances the number of suicide cases goes up. Suicide and accident cases are almost equal in third decade. This trend is because of increasing responsibilities and adjustment problems in the society, which might lead to increased suicidal tendencies.

Among the total number of deaths due to drowning males are almost double that of females. Especially in III, IV and V decades. This may be because of extensive out door activity of men. After V decade the difference between male and female in frequency occurrence is minimal and deaths in old age are mostly suicidal may be because of their chronic ailments and financial difficulties due to negligence of the society.

Among male most of the deaths were due to accidental while in females the cause was suicide. Amongst female victims the percentage of married are more. In the males no much difference between married and unmarried. The incidence of drowning was more in summer when compared to other seasons.

When identity is taken in to consideration, in the I decade nearly all the cases were of known type, even in the II decade also most of the drowning cases

are of known type, but in the III and IV decade nearly half the cases were of unknown type. The above distribution may be because most of the deaths in this age group are due to suicide. And the victims choose a distant place from their residence, from where they were brought to the mortuary as unknown bodies.

Altogether about 25 – 30 % of cases are brought to the mortuary as unknown and in advanced stage of decomposition (may be because of absence of relatives and lack of Panchas, or the inquest may be delayed for some other reasons), in such cases the early signs of drowning on postmortem examination are masked and diatom test becomes the only means of knowing whether death was to ante mortem drowning or postmortem disposal.

90 cases were subjected to diatom analysis out of which 52 cases were found to be positive for diatoms (57.77 %). Two water samples were negative for diatoms. These were found to be P.M. disposals.

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